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Mineral status of OuledDjellal breeding sheep according to food ration

I. Djaalab[1*], Z. Djerrou[1,2], O. Bouaziz[1], A. Allaoui[3], S. Haffaf[3], H. Djaalab[1], S. Mehennaoui[3]

[1]*Institute of Veterinary Sciences, University of Mentouri Constantine, Algeria*

[2]*Department of Sciences of Nature and Life, University of August 20th 1955, Skikda, Algeria*

[3]*Institute of Veterinary and Agricultural Sciences, University of LhadjLakhdarBatna, Algeria*

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Abstract

The study aimed to estimate the mineral status of the sheep breed Ouled Djellal depending on the physiological and nutritional state. The plasma level of some minerals was established to determine the effectiveness of digestion and assimilation of nutrients ewe during peripartum. The assessment of nutritional or metabolic state was highlighted by the physico-chemical analysis of the ration. The results showed that green fodder is richer in crude protein and ash mainly Mg, Na, K, Cu and Zn. The concentrate is the most energy food and that by its high content of organic matter and dietary fiber. By cons, hay despite its woody character, contains the highest levels of Ca and P. In sheep, a significant decrease ($P < 0.01$) in serum calcium and magnesium is observed in late pregnancy. However, plasmatic phosphate increased significantly ($P < 0.01$) in lactation phase. It should be noted that the plasma levels of sodium, potassium and chlorine does not show significant differences ($P > 0.05$) depending on the physiological stage. It is necessary to bring a correction of food with mineral intakes that are consistent with the critical periods of the sheep mitigating the metabolic requirements imposed.

* **Corresponding Author:** I. Djaalab ✉ imendjaalab@gmail.com

Introduction

Sheep farming in semi-arid regions of Algeria faces large fluctuations in the pastoral supply; food context in ruminants in these areas is characterized by inadequate feed supply both qualitatively and quantitatively. On the other hand, pregnancy, parturition and lactation are physiological changes in the body that activate the adaptive mechanisms which their aim is to maintain homeostasis during the peripartum period (Jacob and Vadodaria, 2001). Minerals are heavily involved in the successful reproduction. Fertilization, implantation, fetal and embryonic development are very sensitive to mineral imbalances periods. Deficiencies of calcium or magnesium increase the incidence of dystocia and delayed uterine involution (Poncet, 2002; Vázquez-Armijo and *al*., 2011). It is in this sense that this study was conducted to highlight the influence of physiological state on changes some parameters of mineral profile in order to evaluate the metabolic status and identify which these analyzes could be preachers of the mineral status of breeding sheep.

Materials and methods

The tests were conducted at the experimental farm in the Technical Institute (ITELV) Ain M'Lila of eastern Algeria. This region is located in a semi-arid bioclimatic stage of continental, characterized by hot summers and cool wet winters. The study involved monitoring 40 ewes Ouled Djellal clinically healthy, multiparous, 3 to 5 years, with an average weight of 53.65 ± 4,22Kg. These females undergoes periodic blood tests based on the physiological stage of reproduction: 2 months before the projection (NG), 1 and a half months of gestation (DG), 4 month gestation (FG) and at 1 month postpartum (AL).

Food and water

Rangelands are the basis for animal feed. Sheep enjoying pastures offered by large term steppe plants throughout the year and received in barn vetch hay and oats concentrate (crushed barley, wheat bran). Licks at their disposal and water is served *ad libitum*. A representative sample of each food was collected and analyzed in the laboratory ESPA (Batna) using the methods recommended by the AOAC (1999). Mineral extraction is Performed using nitro-perchloric digestion (Kamoun, 2008) by atomic absorption spectrophotometry flame.

Biochemical analysis

Blood samples were taken by puncture of the jugular vein in the morning before food intake. Blood samples were collected in dry Vacutainers with Venojects: 0.9, then centrifuged immediately at the farm 3000tr / min for 15 min. The corresponding serum samples were stored at -20 ° C. The dosage of mineral metabolism parameters were performed at the University Hospital of Constantine by UV spectrophotometry on PLC (ADVIA 1800 Siemens) for calcium (Ca), phosphorus (P), magnesium (Mg) and electrolytes (RXL Siemens) to sodium (Na), potassium (K) and chlorine (Cl).

Statistical analysis

All data are expressed as mean ± standard error of the mean (m ± SEM). The results were subjected to analysis of variance (ANOVA 1), then a multiple comparison by the test of Newman-Keuls. All these analyze are performed using the Graph Pad Prism software (version 5.03). Differences were considered significant when $P < 0.05$.

Results and discussion

Physico-chemical and mineral composition of ration

Table 1 shows the contents of dry matter (DM), total ash (TA), organic matter (OM) in total nitrogenous materials (TNM), fat and crude fiber (CF) contained in the food eaten by the sheep (expressed as percentage of dry matter).

The physico-chemical analysis revealed that green forages are richer in crude protein and total ash ($p < 0.05$). The concentrate is the more energy and that by its high organic content ($p < 0.01$), furthermore, it contains the most significant content of cell walls. By cons, hay, despite its woody character (12.80 ± 0.60% DM), it has the highest crude fiber ($p < 0.01$). Green feed contains a crude protein value than the results obtained by Arab *et al.* (2009) (12.75 -15% DM) but is closer to the values of Lemnouar-Haddadi (2001) (17% DM). Indeed, the nitrogen sources are particularly important to the extent that in addition to grazing, the concentrate should cover widely varying nitrogen needs during lactation. The contents of the food eaten by the sheep are within the standards of contributions recommended by the literature (Jarrige, 1995).

Table 1. Physical and chemical composition of the ration.

	DM	OM	TA	TNM	FAT	CF
Green fodder	15,39±1,6	89,74±1,07	10,27±1,1	22,90±2,5	1,37±0,16	21,00±1
Concentrated	92,10±0,6	97,63±0,13	2,37±0,12	12,66±0,5	2,44±0,11	2,7±0,7
Vetchhayoats	91,72±2,3	96,28±1,50	3,72±0,61	11,90±0,9	2,00±0,01	33,75±0,9

DM: dry matter, OM: organic matter, TA: total ash, TNM: total nitrogenous materials, CF: crude fiber.

Changes in levels of the major elements (calcium, phosphate, magnesium, sodium, potassium [in g / kg DM]) and trace elements (copper, zinc, manganese, iron [in mg / kg DM or ppm Ms] of the main foods eaten by the sheep are shown in table (2).

Table 2. Mineral composition of the ration.

	Ca	P	Mg	Na	K	Zn	Cu	Fe
Fodder	1,02±0,02	0,71±0,04	3,92±0,42	5,09±0,37	34,14±0,15	63,31±1,14	12,06±0,22	20,25±2
Concentrated	0,95±0,24	3,88±0,65	2,33±0,28	2,02±0,50	7,74±0,77	63,31±12,94	10,51±1,62	86,93±15
Hay	4,57±0,80	7,36±1,11	1,28±0,24	2,19±0,47	6,59±1,47	40,42±4,88	3,72±0,35	157,68±29

We have previously found (Table 1) that the green fodder contained the largest value CF due to the presence of the higher levels of Mg (3.92 g / kg DM), Na (5.09 g / kg DM), K (34.14 g / kg DM), Cu (12,25mg / kg DM) and Mn (35.10 mg / kg DM). Meanwhile, the hay has high contents of Ca (4.57 g / kg DM), P (7,36g / kg DM) and Fe (157.68 mg / kg DM), while the major mineral rate and juvenile concentrate are lowest. For zinc, green fodder and concentrate have similar respective contents (63.31 ± 1.14 and 63.31 ± 12.94 ppm) in contrast to hay (40.42 ± 4.88 ppm). According Meziane (2001), leaching plants by rain and food preservation time (hay and concentrate) are all factors that influence their low levels of TNM, fat and total ash. The determination of mineral content of plants is important because it may reveal deficiencies in minerals in animals (Grace and Clark, 1991).

Mineral profile of sheep depending on the physiological state

Considering the results recorded in Table 3, a significant decrease (P <0.01) in serum calcium and magnesium is observed in late pregnancy. However, phosphate increased significantly (P <0.01) in lactation phase. It is noteworthy that serum sodium, serum chloride and potassium levels present no significant differences (P> 0.05) during different reproductive periods. The results observed in this study are in the range of standards reported by Rekik*et al.* (2010); Gazyağc *et al.* (2011) but remain below the values established by Yokus*et al.* (2004); Aytekin and Aypak (2011).

The low content of calcium in late pregnancy is consistent with the work of Rekik *et al.* (2010) which recorded the lowest content a week before lambing. This situation may be due to intense calcium requirements for the transition to the fetus or for bone mineralization of the skeleton (Yokus*et al.*, 2004). According to Underwood and Suttle (1999), lower blood calcium in late pregnancy would foodborne; Indeed, calcium mobilization can be hampered by inadequate food intake in case of failure of homeostatic mechanisms of the body. The distribution of diets low in calcium during lactation results in a stronger and more sustainable response to absorption when calcium intake is normal (Meziane, 2001). Because food is deficient in calcium especially for green fodder (1,02g / kg DM), which may partially explain the increased blood calcium in milk (89,5mg / l). The high Ca demand by milk production where increased export to Ca milk is estimated at 0.19 g Ca / 100g in sheep (Underwood, 1981).

The observed hypophosphatemia is similarly foodborne (Underwood and Suttle, 1999) that the green fodder, besides being deficient in calcium, are also phosphorus (0.71 g / kg DM). Marco *et al.* (1998) assume that the food factor probably influenced the increased plasma phosphorus level. According to Meschy *et al.* (1995), there is a very significant decline in phosphate levels in the range of 4.09g to 2.5g young grass at the end of the heading and less than 2g in flowering. This rate is confirmed in our farm in the spring, gestation period where there is the lowest value of the year (65,1mg / l). By against the increase in serum phosphate may be linked to the largest distribution of barley for animal *postpartum* period (Meziane, 2001) because the grains are rich in P (3-5 g / kg DM).

Table 3. Changes in plasma concentration of Ca, P, Mg, Na, K, Cl depending on the physiological stage (mean ± SEM).

	NG	DG	FG	AL	P
Ca (mg/l)	97,80±2,99^{abd}	84,40±6,33^{abcd}	76±3,65^{bcd}	89,50±4,61^{abcd}	0,0149
P (mg/l)	67,30± 5,56^{abc}	65,10±6,93^{abc}	71,50±5,28^{abc}	93,20±5,01^{d}	0,0051
Mg (mg/l)	26,50±1,34^{ad}	21,30±0,63^{bc}	19,90±0,73^{bc}	24,40±0,63^{ad}	< 0,0001
Na (mEq/)	144,8±1,71	146,5±2,21	149,1±0,62	150,3±0,81	0,0549
Cl (mEq/)	109,9±0,69	110,0±1,92	110,3±0,95	108,6±0,68	0,7478
K (mEq/)	4,86±0,26	4,66±0,13	4,610±0,21	4,90±0,11	0,6191

Different lowercase letters (a, b, c, d) in the same line indicate significant difference.

The end of gestation coincides with spring, where we found a decrease ($p < 0.001$) Mg plasma level which is related to the very poor young grass in this element and digestibility of Mg is very low and therefore a contribution very low (Meziane, 2001). It is known that acute hypomagniesemia stimulates the secretion of PTH (as hypophosphatemia) and promotes increased intestinal Ca absorption (Underwood and Suttle, 1999). Therefore, in this study, another reason for the high levels of plasma, it could be the result of decreasing levels of magnesium in late pregnancy. Borella*et al.* (1990) suggested that the increasing ratio of Ca / Mg is associated with abortion and pregnancy pathologies. In our study, a ratio of Ca / Mg highest was recorded in early gestation. For this reason, the sheep must be supplemented with magnesium to prevent metabolic disorders in early pregnancy.

Moreover, the highest serum sodium level is recorded in nursing phase (150mEq / l), while the lowest value in non-pregnant ewes (144,8mEq / l). There is a negative correlation between the amount of milk produced and the level of sodium (Przemysław *et al.*, 2008). Azab *et al.* (1999) argue that in ruminants, this electrolyte decreases immediately in postpartum, this is related to the export of sodium ions in the colostrum. Rowland *et al.* (1974) report that serum sodium of animals feeding on lush green pasture, is higher than that of animals ingesting fodder (145.2 mEq / l against 142.5 mEq / l). This may explain in part the increase in serum sodium in ewes in late pregnancy and lactation.

The plasma levels lowest of K was registered during pregnancy. According to Yokus *et al.* (2004), the low concentration of Na increases aldosterone and this reduces plasma levels of K; This, by maintaining the tubular elimination of K. According to our results, the low levels of potassium in early pregnancy may be due to increased aldosterone synthesis, where the latter is stimulated by low sodium and chlorine in the same period (Lippmann, 1995). The results showed the contents of Na and Cl relatively constant in the plasma of sheep grazing conditions and without supplementation (Yokus *et al.*, 2004).

Sodium, potassium and chloride are electrolytes that work together to ensure electrical neutrality of the water body compartments and ion balance (Sanchez and Beede, 1994) which, when disturbed, affects the animal production performance (Mongin, 1981).

Conclusion

It is important, therefore, that the pregnancy creates mineral status disturbances, increasing the nutritional needs of animals. Thus, in these conditions, nutritional deficiencies emerged in particular calcium and magnesium in pregnant ewes; it is necessary to bring a correction of food and this with mineral intakes that are consistent with the critical periods of the sheep mitigating the metabolic requirements imposed. And because of this, it would significantly improve the situation without resorting to cumbersome and costly analyzes, sometimes even difficult.

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